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(71) Applicant(s)
Kvaerner Earl and Wright

(Incorporated in the United Kingdom)

Portland House, Stag Place, LONDON, SW1E 5BH, United Kingdom

(72) Inventor(s)
Poul-Eric Christiansen

(74) Agent and/or Address for Service
Sam Briddes
Kvaerner Earl and Wright, Portland House, Stag Place, LONDON, SW1E 5BH, United Kingdom

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B7A AAAQ
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E1H HEA H604

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GB 2285773 A GB 2207892 A US 4167148 A

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UK CL (Edition O ) B7A AAAP AAAQ , E1H HEA
INT CL$^6$ B63B 21/50 35/44
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# (54) Buoyant Platform

(57) A floating platform comprising in combination a semisubmersible vessel having two or more pontoons 10, buoyant columns 11 upstanding from those pontoons and a deck 12 supported on the columns (the semisubmersible vessel being of a kind known per se); and a raft 21 comprising a hull 22 having a planform greater than the planform of the vessel and two or more buoyant caissons 23 disposed at or near lateral extremities of the raft 21 and configured so that the raft is capable of floating in a stable attitude with the hull of the raft submerged to such a depth that the vessel can float over the hull of the raft with only the buoyant caissons 23 of the raft piercing the water surface, in which the pontoons 10 of the vessel are secured to upper surfaces of the hull 22, Drilling facilities 32 on the vessel can be used to drill and complete wells 24 with surface wellheads which can subsequently be transferred to and connected to raft mounted production equipment 25.

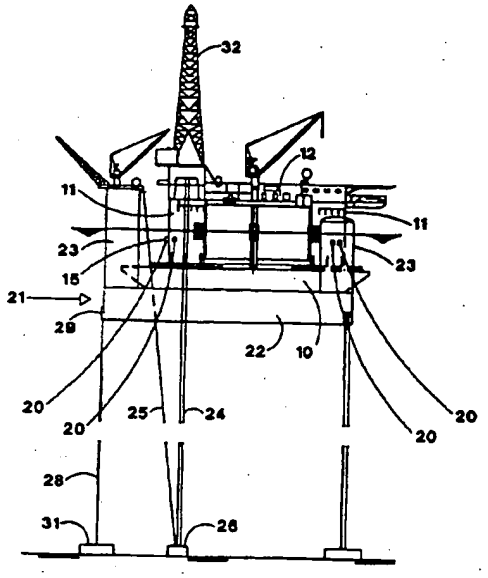


FIG 1

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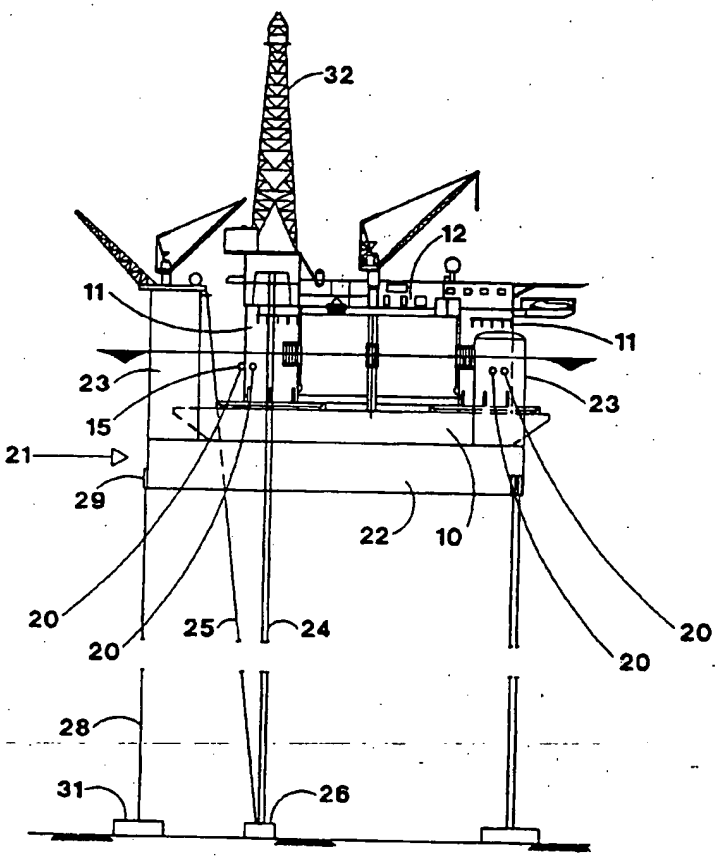
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FIG 1

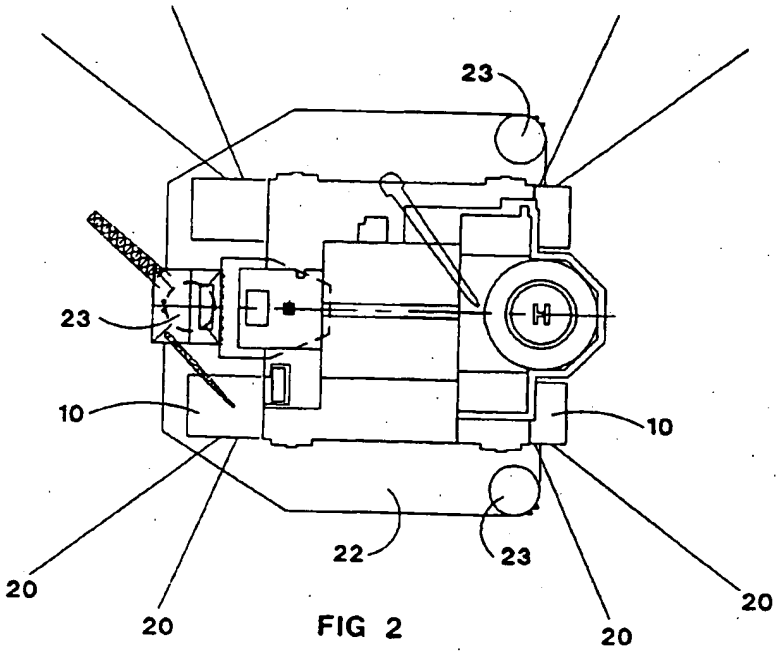
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FIG 2

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# BUOYANT PLATFORM

The invention relates to a buoyant platform, and to a method of assembling such a platform for the development of an offshore oil/gas field.

In particular the invention relates to a buoyant platform formed from an existing semisubmersible vessel secured to an upper surface of a purpose built raft held down against the action of its own buoyancy in the manner of a tension leg platform (TLP). Platforms of this type have been described and claimed in our U.K. Patent Specification No. 2285773A.

Semisubmersible vessels have been used for some years in the offshore industry for the purpose of drilling, production and marine operations. These semisubmersible vessels typically have two parallel spaced apart pontoons with buoyant columns upstanding from those pontoons to support a deck. In transit the vessel is deballasted so that it can float on the pontoons with the columns clear of the water. This allows the vessel to operate as a catamaran. For activities which require a stable offshore platform, the vessel is ballasted down so that the pontoons are submerged, and only the buoyant columns pierce the water surface - thus giving the semisubmersible vessel a substantial buoyancy with a small waterplane area.

This configuration - which is illustrated in U.K. Patent Specification 2068439A - provides a more stable platform for offshore operations than would be provided by a conventional ship shaped vessel. However, for severe seastates, even a semisubmersible vessel becomes subject to movements which are unacceptable for many offshore operations, including inter alia drilling and production. These unacceptable movements lead to 'downtime' during which all the costs of operating the semisubmersible vessel are incurred, but no useful work is done.

Development of offshore oil and gas fields in hostile areas (in terms of severe sea states) has led to requirements for drilling, production and marine operations to be carried out in progressively more severe sea states, with minimum downtime.

Thus there is a requirement for a buoyant platform which is capable of continued operation in more severe sea states than can be tolerated by semisubmersible vessels currently in use. This may be combined with a further requirement for oil storage at an open sea site.

In some cases it may be advantageous to employ mobile drilling facilities on a semisubmersible vessel (which is already equipped with power supplies and drilling equipment) to enhance the capabilities of another floating vessel. An example of this enhancement is shown in U.K. Patent Specification 2250767A, in which two floating vessels are located beside each other.

In the present case the semisubmersible vessel is associated with another floating component, herein referred to as a "raft". Deck load and area limitations, which would normally prevent heavy and bulky equipment from being carried, can be overcome by supporting the semisubmersible vessel on the raft.

It may also be desirable to drill oil/gas wells at a certain location, and then leave those wells tied back to surface wellheads at that location, while the drilling equipment is removed and reused at another location.

The invention provides a floating platform comprising in combination a semisubmersible vessel having two or more pontoons, buoyant columns upstanding from those pontoons and a deck supported on the columns (the semisubmersible vessel being of a kind known per se); and a raft comprising a hull having a planform greater than the planform of the vessel and two or more buoyant caissons disposed at or near lateral extremities of the raft and configured so that the raft is capable of floating in a stable attitude with the hull of the raft submerged to such a depth that the vessel can float over the hull of the raft with only the buoyant caissons of the raft piercing the water surface, in which the pontoons of the vessel are secured to upper surfaces of the hull, and drilling facilities on the vessel can be used to drill and complete wells with surface wellheads which can subsequently be transferred to and connected to raft mounted production equipment.

It is preferred that the semisubmersible vessel can subsequently be released from and floated off the raft when drilling is completed.

It is further preferred that the raft has means whereby after the semisubmersible vessel has been removed, the raft can be submerged to such a depth that no part of the raft pierces the water surface.

It is further preferred that the raft is adapted to rest on the seabed.

In circumstances in which the semisubmersible can be released, the semisubmersible vessel may later be floated over and reconnected to the hull to retrieve the raft mounted wells and wellheads in order to carry out further drilling or workover activities.

It is preferred that the caissons of the raft have mooring clamps to secure the platform on station.

Mooring equipment for the platform may comprise vertical tensioned tethers.

The platform may incorporate dynamic positioning equipment.

It is preferred that the vertical depth of the hull is less at points on the periphery of the hull than it is at the centre of the hull.

It is also preferred that either or both of the upper and lower surfaces of the hull slope upwardly or downwardly (as the case may be) from the edge of the hull towards the centre of the hull.

Peripheral edges of the hull may be profiled to reduce resistance to wave and/or current loads.

It is preferred that the hull has compartments for the storage of oil, and there is provision for counterflooding to compensate for the accumulation or depletion of oil within the hull.

The invention also provides a method of developing an offshore oilfield which comprises the assembly of a platform as described above including the steps of deballasting a semisubmersible vessel so that it floats on its pontoons, ballasting a raft (of the kind described) so that the upper surface of its hull is submerged to a depth greater than the deballasted draft of the vessel, floating the vessel over the hull of the raft, deballasting the raft so that the pontoons of the vessel are raised above water level, and then securing the pontoons of the vessel to upper surfaces of the hull; using drilling facilities on the vessel to drill and complete wells beneath the platform with surface wellheads; and then transferring the surface wellheads to the raft for connection to raft mounted production equipment.

It is preferred that the semisubmersible vessel is subsequently released from and floated off the raft when drilling is completed.

It is further preferred that the semisubmersible vessel is floated over and reconnected to the hull to retrieve the raft mounted wells and wellheads, and further drilling or workover activities are carried out.

A specific embodiment of the invention will now be described by way of example with reference to the accompanying drawings in which:-

Figure 1 is a side view of a buoyant platform;

Figure 2 is an end view of that platform;

As shown in Figure 1, a floating platform includes a generally conventional semisubmersible drilling vessel, which is frequently referred to in the offshore industry as a Mobile Offshore Drilling Unit or MODU. This MODU has two elongated pontoons 10, four buoyant columns 11 (upstanding from the ends of each of those pontoons), and a deck 12 supported on the columns. The pontoons 10 are subdivided internally into selectively ballastable watertight compartments. The MODU has anchor chain lockers within its corner columns, and there are winches (not shown) on the tops of those columns and fairleaders 15 near the bases of those columns for deploying mooring arrays.

The MODU illustrated by way of example is in fact a SEDCO 600 series semisubmersible drilling vessel, of which three were located worldwide in various operating roles at the time of making this application. This MODU is configured for end bay drilling.

Following the invention, the MODU is releasably secured to a purpose built raft 21. The raft has a generally flat hull 22 with a planform larger than the planform of the MODU. The hull 22 has three caissons 23 (located at two adjacent corners and midway along its opposite side), and these caissons stand slightly higher above the upper surface of the hull 22 than the vertical draft of the pontoons 10 of the MODU in their deballasted condition. A raft having a generally flat hull and at least two upstanding caissons at or near its lateral extremities will be referred to as a raft of the kind described.

In the simplest form of the invention, the MODU is secured to the upper surface of the hull 22 between the caissons 23. In this way the raft 21 gives additional buoyancy to the MODU, and also improves the stability characteristics of the MODU. Fixing the MODU to the raft 21 reduces the wave loads applied to the MODU, because these loads are reacted largely by the raft. Thus fatigue lives in structural elements of the MODU will be significantly improved.

The raft 21 may have internal compartments for ballast water and the storage of oil. These compartments are not shown in detail in the Figures, but if the raft were to be made of steel, these would be constructed like conventional compartments of an ocean going VLCC (Very Large Crude Carrier). If the raft were to be made of concrete, the compartments would be formed like cells in a conventional concrete structure.

The raft is fitted with pipework and one or two pump rooms as required for ballast and oil transfer operations. The raft pump rooms are typically located directly below the pump rooms in the MODU pontoons with watertight access from these pontoons. Electrical feeders and pipework to the raft pump rooms can therefore easily be run via the normal routes up through the columns of the MODU.

To compensate for changes in buoyancy in a steel raft, counter flooding arrangements would be necessary, so that sea water could replace or be replaced by oil as the compartments were emptied or filled. Advantageously a flexible compartment liner could physically separate the oil and the sea water to be used as ballast. Because of the large mass of a concrete raft, it is unlikely that counterflooding would be necessary. However, if dry oil storage was adopted, it might be necessary to fill the tops of the storage compartments with an inert gas.

The raft 21 has a moonpool through which drill strings 24 and subsequently rigid or flexible riser systems 25 can be run to the seabed, as shown particularly in Figure 1. The drill strings 24 are deployed from a drilling derrick 32 on the deck 12 of the MODU. The drilling equipment (power supplies, mud tank etc.) is mounted on the MODU, and only minimal facilities are mounted on the caissons 23 of the raft 21. In this case the raft will be required to remain on location over a drilling template or production manifold 26, which is secured to the seabed. Following the invention, when the wells and wellheads are completed, they can be transferred (under tension) from the deck of the MODU to a caisson 23 of the raft 21.

In a preferred method of keeping the platform on location, the raft 21 is held down against the action of its own buoyancy in the manner of a Tension Leg Platform or TLP. In this case tethers 28 extend down from tensioning devices 29 beneath the caissons 23 to foundation templates 31 on the seabed. Conventional mooring lines 20 are deployed from the winches of the MODU and through fairleaders 15 to anchors on the seabed. The mooring lines 20 are set out to a conventional eight anchor mooring array (seen best in Figure 2). The mooring lines 20 can be used to position the combined floating platform (i.e. MODU plus raft) over the required drilling location prior to commencement of drilling operations.

An important feature of the invention relates to an alternative mooring arrangement. The fairleaders shown in Figure 1 can be repositioned on the caissons 23, and can be arranged to clamp the mooring lines 20, so that the mooring loads are carried in the raft 21 rather than in the MODU itself. In use the winches (not shown) are used to adjust the mooring lines 20, which are then clamped in the fairleaders 15 on the caissons.

In a variation of the basic configuration of the raft, the hull 22 may be slightly dome shaped so that its draft at its centre is less than its draft around its periphery. With a dome shaped raft, the platform will ride the waves better, and so in theory a smaller air gap would be required between the nominal sea level and the lowest elements of the deck.

Turning now to the construction and assembly of the platform, many MODU's already exist which could be used as the upper part of the platform. The purpose built raft 21 is of simple construction, and could be built in sections in conventional shipyards and then assembled in sheltered water. Alternatively, the raft could be formed of concrete. Using conventional shipbuilding or concrete pouring techniques, the raft (with internal compartments for the storage of oil) could be constructed and assembled very economically.

To assemble the complete platform, the raft 21 would be ballasted down so that only the tops of the caissons 23 were above sea level. The MODU would be de-ballasted so that it floated only on its pontoons 10, and would then be positioned over the raft 21. The raft 21 would be deballasted so that the upper surface of its hull 22 was above sea level and the MODU was clear of the water. In this condition the pontoons of the MODU could be secured to the upper surface of the hull.

When drilling operations are completed, and the drilling derrick 32 and associated drilling equipment are no longer required at that particular location, the MODU would be released from the raft 21, and floated off to another location.

When the MODU has been released, the raft could be drawn down towards the seabed by selective ballasting and/or adjustment of its moorings. The raft would be totally submerged to a depth no deeper than that at which diver intervention on the wellheads is possible. The raft could either be secured at a mid water depth position, or could rest on the seabed if the depth of the sea at that point was shallow. This feature would be of value at locations which are threatened in winter months by drifting ice. The MODU could later return for further drilling or work over operations (e.g. during the following summer).

In one form of the invention, the raft - once in position on site - could be permanently located below the water surface.

The invention has the advantage that a single MODU can be used at several locations where surface or near surface wellheads are required. The sophisticated mechanical equipment on the MODU could be used sequentially in combination with several low cost rafts. The raft(s) provide extra buoyancy and greater stability to the MODU while drilling is in progress, so that drilling can continue in more severe sea states than would otherwise be possible.

CLAIMS

1. A floating platform comprising in combination a semisubmersible vessel having two or more pontoons, buoyant columns upstanding from those pontoons and a deck supported on the columns (the semisubmersible vessel being of a kind known per se); and a raft comprising a hull having a planform greater than the planform of the vessel and two or more buoyant caissons disposed at or near lateral extremities of the raft and configured so that the raft is capable of floating in a stable attitude with the hull of the raft submerged to such a depth that the vessel can float over the hull of the raft with only the buoyant caissons of the raft piercing the water surface, in which the pontoons of the vessel are secured to upper surfaces of the hull, and drilling facilities on the vessel can be used to drill and complete wells with surface wellheads which can subsequently be transferred to and connected to raft mounted production equipment.

2. A floating platform as claimed in Claim 1 in which the semisubmersible vessel can subsequently be released from and floated off the raft when drilling is completed.

3. A floating platform as claimed in Claim 2, in which the raft has means whereby after the semisubmersible vessel has been removed, the raft can be submerged to such a depth that no part of the raft pierces the water surface.

4. A floating platform as claimed in Claim 3, in which the raft is adapted to rest on the seabed.

5. A floating platform as claimed in any one of Claims 2 to 4 in which the semisubmersible vessel can be floated over and reconnected to the hull to retrieve the raft mounted wells and wellheads in order to carry out further drilling or workover activities.

6. A floating platform as claimed in any one of the preceding claims in which the caissons of the raft have mooring clamps to secure the platform on station.

7. A floating platform as claimed in any one of the preceding claims in which mooring equipment comprises vertical tensioned tethers.

8. A floating platform as claimed in any one of the preceding claims in which the platform incorporates dynamic positioning equipment.

9. A floating platform as claimed in any one of the preceding claims in which the vertical depth of the hull is less at points on the periphery of the hull than it is at the centre of the hull.

10. A floating platform as claimed in any one of the preceding claims in which either or both of the upper and lower surfaces of the hull slope upwardly or downwardly (as the case may be) from the edge of the hull towards the centre of the hull.

11. A floating platform as claimed in any one of the preceding claims in which peripheral edges of the hull are profiled to reduce resistance to wave and/or current loads.

12. A floating platform as claimed in any one of the preceding claims in which the hull has compartments for the storage of oil, and there is provision for counterflooding to compensate for the accumulation or depletion of oil within the hull.

13. A floating platform substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

14. A method of developing an offshore oilfield which comprises the assembly of a platform as claimed in any one of the preceding claims including the steps of deballasting a semisubmersible vessel so that it floats on its pontoons, ballasting a raft (of the kind described) so that the upper surface of its hull is submerged to a depth greater than the deballasted draft of the vessel, floating the vessel over the hull of the raft, deballasting the raft so that the pontoons of the vessel are raised above water level, and then securing the pontoons of the vessel to upper surfaces of the hull; using drilling facilities on the vessel to drill and complete wells beneath the platform with surface wellheads; and then transferring the surface wellheads to the raft for connection to raft mounted production equipment.

15. A method as claimed in Claim 14 in which the semisubmersible vessel is subsequently released from and floated off the raft when drilling is completed.

16. A method as claimed in Claim 15 in which the semisubmersible vessel is floated over and reconnected to the hull to retrieve the raft mounted wells and wellheads, and further drilling or workover activities are carried out.

17. A method substantially as hereinbefore described with reference to the accompanying drawings.

**Amendments to the claims have been filed as follows**

1. A floating platform comprising in combination a semisubmersible vessel having two-or more pontoons, buoyant columns upstanding from those pontoons and a deck supported on the columns (the semisubmersible vessel being of a kind known per se); and a raft comprising a hull having a planform greater than the planform of the vessel configured so that the raft is capable of floating in a stable attitude with the hull of the raft submerged to such a depth that the vessel can float over the hull of the raft, in which the pontoons of the vessel are secured to upper surfaces of the hull, drilling facilities on the vessel are adapted to drill and complete wells with surface wellheads, and the platform has means to transfer and connect the surface wellheads to raft mounted production equipment.

2. A floating platform as claimed in Claim 1 in which means securing the pontoons of the semisubmersible vessel to the raft can subsequently be released, so that the vessel can be floated off the raft when drilling is completed.

3. A floating platform as claimed in Claim 2, in which the raft has means whereby after the semisubmersible vessel has been removed, the raft can be submerged to such a depth that no part of the raft pierces the water surface.

4. A floating platform as claimed in Claim 3, in which the raft is adapted to rest on the seabed.

5. A floating platform as claimed in any one of Claims 2 to 4 in which the semisubmersible vessel can be floated over and reconnected to the hull to retrieve the raft mounted wells and wellheads in order to carry out further drilling or workover activities.

6. A floating platform as claimed in any one of the preceding claims in which the raft has mooring clamps to secure the platform on station.

7. A floating platform as claimed in any one of the preceding claims in which mooring equipment comprises vertical tensioned tethers.

8. A floating platform as claimed in any one of the preceding claims in which the platform incorporates dynamic positioning equipment.

9. A floating platform as claimed in any one of the preceding claims in which the vertical depth of the hull is less at points on the periphery of the hull than it is at the centre of the hull.

10. A floating platform as claimed in any one of the preceding claims in which either or both of the upper and lower surfaces of the hull slope upwardly or downwardly (as the case may be) from the edge of the hull towards the centre of the hull.

11. A floating platform as claimed in any one of the preceding claims in which peripheral edges of the hull are profiled to reduce resistance to wave and/or current loads.

12. A floating platform as claimed in any one of the preceding claims in which the hull has compartments for the storage of oil, and there is provision for counterflooding to compensate for the accumulation or depletion of oil within the hull.

13. A floating platform comprising in combination a semisubmersible vessel having two or more pontoons, buoyant columns upstanding from those pontoons and a deck supported on the columns (the semisubmersible vessel being of a kind known per se); and a raft comprising a hull having a planform greater than the planform of the vessel configured so that the raft is capable of floating in a stable attitude with the hull of the raft submerged to such a depth that the vessel can float over the hull of the raft, in which the pontoons of the vessel are secured to upper surfaces of the hull, and drilling facilities on the vessel can be used to drill and complete wells with surface wellheads which can subsequently be transferred to and connected to raft mounted production equipment, and in which the semisubmersible vessel can subsequently be released from and floated off the raft when drilling is completed.

14. A floating platform as claimed in any one of the preceeding claims in which the raft has two or more buoyant caissons disposed at or near lateral extremities of the raft.

15. A floating platform substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

16. A method of developing an offshore oilfield which comprises the assembly of a platform as claimed in any one of the preceding claims including the steps of deballasting a semisubmersible vessel so that it floats on its pontoons, ballasting a raft so that the upper surface of its hull is submerged to a depth greater than the deballasted draft of the vessel, floating the vessel over the hull of the raft, deballasting the raft so that the pontoons of the vessel are raised above water level, and then securing the pontoons of the vessel to upper surfaces of the hull; using drilling facilities on the vessel to drill and complete wells beneath the platform with surface wellheads; and then transferring the surface wellheads to the raft for connection to raft mounted production equipment.

17. A method as claimed in Claim 15 in which the semisubmersible vessel is subsequently released from and floated off the raft when drilling is completed.

18. A method as claimed in Claim 16 in which the semisubmersible vessel is floated over and reconnected to the hull to retrieve the raft mounted wells and wellheads, and further drilling or workover activities are carried out.

19. A method substantially as hereinbefore described with reference to the accompanying drawings.

The Patent Office

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**Application No:** GB 9611740.3
**Claims searched:** 1-17

**Examiner:** Alan Habbijam
**Date of search:** 2 August 1996

## Patents Act 1977
## Search Report under Section 17

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B7A (AAAP, AAAQ) : E1H (HEA)

Int Cl (Ed.6): B63B 21/50, 35/44

Other: Online:WPI

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage | | Relevant to claims |
|---|---|---|---|
| X,P | GB 2285773 A | (KVAERNER EARL AND WRIGHT) see Figs 3&4 and related description in particular. | 1&6-12. |
| X | GB2207892 A | (GOTAVERKEN ARENDAL) see pages 4&5 and Fig 3 in particular. | 1&12. |
| A | US 4167148 | (FAYREN) see col 5 line64-col6 line4 | 1. |

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| X | Document indicating lack of novelty or inventive step | A | Document indicating technological background and/or state of the art. |
| Y | Document indicating lack of inventive step if combined with one or more other documents of same category. | P | Document published on or after the declared priority date but before the filing date of this invention. |
| & | Member of the same patent family | E | Patent document published on or after, but with priority date earlier than, the filing date of this application. |